SECTION 16231
PACKAGED ENGINE GENERATORS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the following:
   1. Packaged diesel engine driven generators.

B. Related Sections: The following sections contain requirements that relate to this section:
   1. Division 03, Section 03300, Cast-in-Place Concrete.
   2. Division 15, Section 15050, Piping Systems.
   3. Division 15, Section 15250, Mechanical Insulation.
   4. Division 15, Section 15891, Ductwork.
   5. Division 16, Section 16050, Basic Materials and Methods.
   6. Division 16, Section 16415, Automatic Transfer Switch.
   7. Division 16, Section 16450, Grounding.

1.2 DEFINITIONS

A. Standby Rating: Power output rating equal to the power the generator set delivers continuously under normally varying load factors for the duration of a power outage.

B. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

C. Steady-State Voltage Modulation: The uniform cyclical variation of voltage within the operational bandwidth, expressed in Hertz or cycles per second.

1.3 REFERENCES

A. Occupational Safety and Health Administration (OSHA):
   1. OSHA 29 CFR 1910.7.

B. National Fire Protection Association (NFPA):
   1. NFPA 70, 1999 National Electric Code.
   2. NFPA 99, 1996 Health Care Facilities.
   3. NFPA 110, 1996 Emergency and Standby Power Systems.
   4. NFPA 37, 1994 Installation and Use of Stationary Combustion Engines and Gas Turbines.

C. American Society of Mechanical Engineers (AMSE):
   1. ASME B15.1, 1992 Safety Standard for Mechanical Power Transmission Apparatus.

D. National Electrical Manufacturers Association (NEMA):
   1. NEMA MG1, 1993 Motors and Generators (Including Rev. 1 and 2).
   2. NEMA 250, 1992 Enclosures for Electrical Equipment (1,000 Volts Maximum).
   3. NEMA ICS6, 1993 Industrial Control and Systems: Enclosures.
   4. NEMA AB1, 1993 Molded Case Circuit Breakers and Molded Case Switches.

E. American Society of Testing and Materials (ASTM):
   1. ASTM B88, 1995 Specifications for Seamless Copper Water Tube.

2. ASTM A53, 1995 Pipe, Steel, Black, and Hot-Dipped, Zinc-Coated Welded and Seamless.

F. Underwriters Laboratories, Inc. (UL):
1. UL 142, Steel Aboveground Tanks for Flammable and Combustible Liquids.
2. UL 1236, Battery Chargers for Changing Engine Starting Batteries.
3. UL 891, 1994 Dead-Front Switchboards.
4. UL 489, 1991 (Rev. 1995) Molded Case Circuit Breakers and Circuit Breaker Enclosures.

G. Institute of Electrical and Electronics Engineers (IEEE):
1. IEEE 115, IEEE Guide, Test Procedures for Synchronous Machines.

1.4 SUBMITTALS

A. Product Data: Provide data on features, components, ratings, and performance, include the following:
1. Dimensioned outline plan and elevation drawings of engine generator set and other components specified.
2. Thermal damage curve for generator.
3. Time-current characteristic curves for generator protective device.

B. Shop Drawings: Indicate fabrication details, dimensions, weights, loads, required clearances, methods of field assembly, components, and location and size of each field connection.
1. Design Calculations: Signed and sealed by a qualified professional engineer. Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
2. Vibration Isolation Base Details: Signed and sealed by a qualified professional engineer. Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include base weights.
3. Wiring Diagrams: Detail wiring for power and control connections and differentiate between factory-installed and field-installed wiring.

C. Qualification Data: For firms and persons specified in "Quality Assurance" Article.

D. Field Test and Observation Reports: Indicate and interpret test results and inspection records relative to compliance with performance requirements.

E. Certified summary of prototype-unit test report.

F. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.

G. Certified Summary of Performance Tests: Demonstrate compliance with specified requirement to meet performance criteria for sensitive loads.

H. Factory Test Reports: For units to be shipped for this Project, showing evidence of compliance with specified requirements.

I. Exhaust Emissions Test Report: To show compliance with applicable regulations.

J. Sound or noise measurement test report.

K. Certification of Torsional Vibration Compatibility: Comply with NFPA 110.

L. Field test report of tests specified in Part 3.

M. Maintenance Data: For each packaged engine generator and accessories to include in maintenance manuals specified in General and Supplementary Conditions. Include the following:
   1. List of tools and replacement items recommended to be stored at the site for ready access. Include part and drawing numbers, current unit prices, and source of supply.
   2. Detail operating instructions for both normal and abnormal conditions.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Maintain a service center capable of emergency maintenance and repairs at the Project with eight hours' maximum response time.

B. Testing Agency Qualifications: Testing agency as defined by OSHA in 29 CFR 1910.7 or a member company of the InterNational Electrical Testing Association and that is acceptable to authorities having jurisdiction.

C. Source Limitations: Obtain packaged engine generator and auxiliary components specified in this Section through one source from a single manufacturer.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

E. Comply with NFPA 70.

F. Comply with NFPA 99.

G. Comply with NFPA 110 requirements for Level 1 emergency power supply system.

H. Comply with NFPA 110 requirements for Level 2 emergency power supply system.

I. Engine Exhaust Emissions: Comply with applicable federal, state, and local government requirements.

J. Noise Emission: Comply with applicable state and local government requirements for maximum noise level at 10 feet from unit in all horizontal locations due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other components of the installation.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver engine generator set and system components to their final locations in protective wrappings, containers, and other protection that will exclude dirt and moisture and prevent damage from construction operations. Remove protection only after equipment is safe from such hazards.

1.7 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of Contract Documents.

B. Special Warranty: Written warranty, executed by manufacturer agreeing to repair or replace packaged engine generator and auxiliary components that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.

1.8 MAINTENANCE SERVICE

A. Maintenance: At Substantial Completion, begin 12 months' full maintenance by skilled employees of the manufacturer's designated service organization. Include quarterly exercising to check for proper, starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Maintenance agreements shall include parts and supplies as used in the manufacture and installation of original equipment.

1.9 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Fuses: One for every ten of each type and rating, but not less than one of each.
   2. Indicator Lamps: Two for every six of each type used, but not less than two of each.
   3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.

PART 2 - PRODUCTS

2.1 Packaged engine generators are included as part of the directed procurement program for this project. The Construction Manager is administering the program and equipment shall be purchased in accordance with program requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, equipment foundations, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine generator performance.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Examine roughing-in of exhaust system piping systems and electrical connections. Verify actual locations of connections before packaged engine generator installation.

3.2 CONCRETE BASES

A. Install concrete bases of dimensions indicated for packaged engine generators. Refer to Division 3, Section 03300, "Cast-in-Place Concrete" and Division 16, Section 16050, "Basic Materials and Methods."

3.3 INSTALLATION

A. Comply with packaged engine generator manufacturers' written installation and alignment instructions, and with NFPA 110.

B. Set packaged engine generator set on concrete bases.
   1. Support generator-set mounting feet on rectangular metal blocks and shims or on metal wedges having small taper, at points near foundation bolts to provide 3/4- to 1-1/2-inch (19- to 38-mm) gap between set base and foundation for grouting.

2. Adjust metal supports or wedges until generator is level.

C. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.

D. Install exhaust-system piping, accessories, hangers and supports, and anchors for complete installation.
1. Extend breather piping from engine to exterior near radiator discharge.

E. Install exhaust-system piping for diesel engines. Extend to point of termination outside structure. Size piping according to manufacturer's written instructions.

F. Install condensate drain piping for diesel-engine exhaust system. Extend drain piping from low points of exhaust system and from muffler to condensate traps to point of disposition.

G. Install flow meters and sensors where indicated. Install flow-measuring system components and make connections according to manufacturer's written instructions.

H. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.
1. Verify that electrical wiring is installed according to manufacturers' submittal and installation requirements in Division 16, Section 16120. Proceed with equipment startup only after wiring installation is satisfactory.

3.4 CONNECTIONS

A. Piping installation requirements are specified in Division 15 Sections. Drawings indicate general arrangement of piping and specialties. The following are specific connection requirements:
1. Install piping adjacent to engine generator to allow service and maintenance.
2. Connect exhaust-system piping to diesel engines.

B. Electrical wiring and connections are specified in Division 16 Sections.

C. Ground equipment.
1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.5 IDENTIFICATION

A. Identify system components according to Division 15 Section "Identification and Labeling" and Division 16 Section 16196, "Electrical Identification."

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections, and to assist in testing. Report results in writing.

B. Testing: Perform field quality-control testing under the supervision of the manufacturer's factory-authorized service representative.

C. Tests: Include the following:
1. Tests recommended by manufacturer.

2. InterNational Electrical Testing Association Tests: Perform each visual and mechanical inspection and electrical and mechanical test stated in NETA ATS for emergency engine generator sets, except omit vibration baseline test. Certify compliance with test parameters for tests performed.
3. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, the following:
   a. Single-step full-load pickup test.
4. Battery Tests: Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery. Verify acceptance of charge for each element of battery after discharge. Verify measurements are within manufacturer's specifications.
5. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
6. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine generator system before and during system operation. Check for air, exhaust, and fluid leaks.
7. Exhaust-System Back-Pressure Test: Use a manometer with a scale exceeding 40 inches wg (120 kPa). Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.
8. Exhaust Emissions Test: Comply with applicable government test criteria.
9. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.
10. Harmonic-Content Tests: Measure harmonic content of output voltage under 25 percent and at 100 percent of rated linear load. Verify that harmonic content is within specified limits.
11. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at four locations within the room, and compare measured levels with required values.

D. Coordinate tests with tests for transfer switches and run them concurrently.

E. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

F. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

G. Test instruments shall have been calibrated within the last 12 months, traceable to standards of the National Institute for Standards and Technology, and adequate for making positive observation of test results. Make calibration records available for examination on request.

3.7 BATTERY EQUALIZATION

A. Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.

3.8 CLEANING

A. On completion of installation, inspect system components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish. Clean components internally using methods and materials recommended by manufacturer.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Construction Manager specified maintenance personnel to adjust, operate, and maintain packaged engine generators as specified below:
   1. Coordinate this training with that for transfer switches.
   2. Train the specified maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment.
   3. Review data in maintenance manuals. Refer to General and Supplementary Conditions' sections "Contract Closeout" and "Operation and Maintenance Data."
   4. Schedule training with Construction Manager, with at least seven days' advance notice.
   5. Minimum Instruction Period: Eight hours.

END OF SECTION 16231